country. Maps and river bulletins were furnished all outgoing steamers for distribution along the river, and every possible means was employed to obtain and distribute information. In this way the people throughout the threatened district were at all times in close touch with this Bureau, whose work in this connection has been highly commended by many of those benefited thereby. It is worthy of note that the usual excitement attendant upon severe floods was noticeably absent this year. This was largely due to the conservative tone of the reports issued, and to the fact that newspapers, as a rule, refrained from publishing alarming and exaggerated accounts of the flood. This was very beneficial and prevented many people from incurring the unnecessary expense of moving property and families, and enabled planters to retain their negro workmen, who would have otherwise fled.

The third important rise of the season began about May 1, reaching its maximum at Madrid on the 7th, Memphis on the 9th, and Helena on the 11th. At Helena, only, did the water reach the danger line, Memphis being 0.8 of a foot, and New Madrid 0.5 of a foot below that mark. The crest stages on this rise were accurately predicted from six to eight days in advance, the stages forecast in no case showing a variation of over 0.3 of a foot. The following are the maximum stages recorded during the May rise: New Madrid, 33.5; Memphis, 32.2; and Helena, 42.0 feet. Owing to the lateness of the season and the damaging effect that an overflow would have at this time, especially upon growing crops, those having farming interests at stake were very anxious as to the outcome of the rise. However, as forecast, it did not cause the river to overflow its banks to any great extent, and no material damage resulted.

There was also a flood in the Colorado River of Texas during the early days of the month, due to heavy general rains. Warnings were issued on the 4th for danger-line stages below Austin, and they were fully verified. In the Brazos River the stages, while quite high, did not reach dangerous proportions.

There is nothing further of special interest to be mentioned, except the somewhat remarkable fact that ice in considerable quantities, the last remnants of the great gorge of the winter of 1903–4, was observed along the Susquehanna River between Harrisburg and York Haven, Pa., after the middle of the month.

The highest and lowest water, mean stage, and monthly range at 188 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, District Forecaster.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Divison.

The following summaries relating to the general weather and crop conditions during May are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—Generally too dry and cool for growth; warm weather and fairly general rains during the last week beneficial, though drought continued in southeastern counties. Cotton stands generally inferior; plants small, but improving at close of month, when the crop was mostly chopped. Corn did fairly well; some upland corn laid by, some in tassel during last week, when oats and wheat were being cut; oats light yield; wheat fair to good; minor crops fair.—*F. P. Chaffee.*

Arizona.—Moderate temperatures prevailed during May. The precipitation was above normal, most of it occurring on the 10th and 11th. Crops in the lower Colorado Valley made fine growth. Local showers early in the month revived vegetation elsewhere, but the dry weather which followed largely overcame the beneficial effect of those showers and crops were again in poor condition. The ranges, which were improved by the rain, again deteriorated. Stock generally suffered greatly.—*M. E. Blystone.*

Arkansas.—Cool, with less than the usual amount of rain. Cotton planting completed; early planted fair stand; late planted fair to good; plant small but healthy; chopping well advanced. Corn planting completed; stand fair to good; cultivation general; being laid by in southern portion at close of month; stalk small but healthy. Oats and wheat promising; heading in southern portion at close of month. An average crop of apples and peaches of excellent quality indicated.—*Edward B. Richards.*

California.—Dry northerly winds during the month caused considerable damage to grain and vegetables, and high winds on the 24th and 25th seriously injured cherries and other deciduous fruits in some sections. The grain and fruit crops promise to fall below early estimates in nearly all parts of the State. Barley harvest and haying are progressing. The hay crop is large and of excellent quality. Deciduous fruits are ripening and citrus fruits are in good condition.—*G. H. Willson.*

Colorado.—Month favorable. Planting of corn and early potatoes was finished. Potatoes were a good stand, but the weather was too cool and wet for corn. Fall grain, alfalfa, and range grass improved steadily. Gardens were good and the prospect for fruit was fine, only slight damage resulting from frost. Beet thinning, melon planting, and tomato setting were under way. Floods caused considerable damage in the Poudre Valley during night of 20th.—*F. H. Brandenburg.*

Florida.—The month was dry and mostly cool, conditions favorable for farm work, but not conducive to the germination of seed and the growth of plants. Early planted cotton advanced very well and at the close of the month was fruiting freely; late planting was backward; poor stands were general. Corn suffered for rain and the crop from the early planting will be short. Citrus fruits dropped freely as result of drought. Pineapples were cut off very much. Peaches were plentiful, but small.—*A. J. Mitchell.*

Georgia.—The first half of the month was moderately cool, the latter part abnormally warm. This was the eighth consecutive month with precipitation below average. Crop conditions were serious, drought prevailed until the very last of the month, when beneficial showers occurred and relieved a situation that was viewed with grave apprehension. Cotton made slow growth. Spring oats were almost a failure. Corn was abnormally small. Fruit prospects were bright.—*J. B. Marbury.*

Idaho.—The driest May on record; irrigated crops made satisfactory progress, as a rule, but some unirrigated hay and grain and late sown sugar beets suffered from drought. There was some damage to fruit by frost, but not sufficient to affect the general yield materially. Range grass made excellent growth and stock made good gains. Streams remained high from melting snow.—*Edward L. Wells.*

Illinois.—The month opened with unseasonable weather, but quite favorable conditions followed, beginning during the first decade and continuing for the most part during the remainder of the month. Considerable advance was made in corn planting; about one-half the crop was in the ground by the 15th, and by the end of the month corn was mostly all planted in the northern portion, and the work was well advanced in the southern. Oats, wheat, and grasses were generally promising.—*Wm. G. Burns.*

Indiana.—Farming operations continued behind throughout the month. On account of poor crop prospects much wheat was plowed up; the remainder promised light crop. Sowing oats was finished during first decade, prospects favorable for good crop. Corn planting began about May 10, and was unfinished at end of month; much replanting necessary on account of cutworms. Old clover thin and weedy, other hay crops promising. Peaches promised light crop; other fruits fair to excellent prospects.—*W. T. Blythe.*

Iowa.—May was about normal as to temperature and rainfall, with generally favorable conditions for planting, germination of seed, and cultivation. Delay in planting was caused in limited areas by excess of rainfall on previously saturated soil. As a whole the month was favorable for field operations, germination of seed, and normal growth of grasses, cereals, potatoes, and garden truck. Fruits were more promising than in recent years.—*John R. Sage.*

Kansas.—Wheat continued in good condition, had headed in the southern counties, and was heading in the central. Spring wheat made good growth. The wet weather retarded corn planting and the cool nights retarded its growth, yet by the end of the month the corn was coming up in the northern counties and was being cultivated in the southern. Oats, barley, and grass made good progress. Alfalfa was ready to cut in several counties by close of month.—*T. B. Jennings.*

Kentucky.—Moderate warmth during the first week was followed by cool weather until about the 20th, checking the growth of crops. The temperature rose afterwards and warm weather continued until the end of the month. The rainfall was a little less than normal and irregularly distributed. Wheat improved decidedly during the month. Corn advanced well during the last ten days. The month closed with tobacco setting in progress. Crops generally in good condition.—*H. B. Hersey.*

Louisiana.—Cotton planting was completed under favorable conditions; prevailing low temperatures caused poor stands in some localities and retarded growth, but warmer weather at close of month proved more favorable; the plant was small but healthy. Corn grew slowly; the crop was well cultivated. Cane grew slowly but was generally promising. Irrigated rice did well; the rainfall was not sufficient for Providence rice. Truck gardens gave good yields.—*I. M. Cline.*

Maryland and Delaware.—Temperature and sunshine were above nor-

mal. Precipitation was below normal and unevenly distributed, but ample until last decade, when rain was much needed. Wheat made decided improvement and reached almost average condition. Oats and rye excellent. Corn germinated poorly and stands were unsatisfactory. Pastures were short until the last decade. Enough fruit set to give fair returns. Strawberry crop reduced by drought. Tobacco setting delayed by dry weather; plants were plentiful and thrifty. Potatoes and peas made excellent progress.—*Oliver L. Fassig.*

Michigan.—Most of May was too cool and dry in the principal agricultural counties for normal germination and growth. Field work progressed favorably. Wheat, rye, meadows, and pastures made fair growth, but the general condition of wheat at the close of the month was very poor. Oats, peas, sugar beets, and early potatoes germinated nicely, but slowly. Corn planting was general during the last decade, but much replanting was necessary on account of the unusually poor seed. All fruits, except peaches, continued promising.—*C. F. Schneider.*

Minnesota.—Showers from 5th to 13th and from 21st to 26th were beneficial except in north, where first rainy period delayed seeding of wheat and oats. Seeding of wheat, oats, barley, and flax and planting of corn and potatoes were finished by the 31st, except scattered areas of corn, barley, flax, and potatoes. Pastures, haylands, and fruit were promising. Temperatures were low for corn, but favorable for wheat, oats, and barley.—*T. S. Outram.*

Mississippi.—On account of unseasonably cool weather crops were backward, but unusually well cultivated. Drought injured stands of corn and cotton in some northern counties, and lice damaged cotton in a few southeastern counties; elsewhere stands were generally good. Chopping cotton and laying by corn were about completed. Oats were being harvested, with fair to good yields. Sugar cane, minor crops, and gardens generally did well. Early peaches were yielding well. Vegetable shipments were heavy.—*W. S. Belden.*

Missouri.—The month was generally unfavorable for farm work and plant growth; the temperature was only slightly below normal, but sunshine was needed, as cloudy conditions prevailed. Rains were general and heavy. Farm work was much retarded and for several days completely stopped. Corn was about two-thirds planted; the most favorable progress was noted in the southern sections. Wheat continued in fair condition; oats improved during the latter part of the month; peaches fair; apples poor.—*George Reeder.*

Montana.—The temperature conditions were generally favorable for stock and farm work, there having been no severe cold changes. Precipitation decidedly below normal but uniformly distributed throughout the month. Moisture sufficient in most sections for range and crops; irrigation unnecessary till latter part. Plowing and seeding of oats and spring wheat nearly finished by 15th, potatoes mostly planted by the close. Sheep and cattle improved steadily, and the month was unusually favorable for lambing. Fruit not materially damaged by frost.—*R. F. Young.*

Nebraska.—Generous and well distributed showers supplied ample moisture for crops without interfering seriously with farm work. Corn generally was planted before the 20th. Low temperature was unfavorable for germination and growth. Oats came up slowly with rather thin stand. Early planted corn came up poorly, and some replanting was necessary. Winter wheat, grass, and alfalfa made good growth. Plum, peach, and cherry trees blossomed very full, and promised large crop. Apple blossoms were less abundant.—*G. A. Loveland.*

Nevada.—The temperature was about normal, and the precipitation slightly deficient. The weather of the month was quite favorable to farming interests in all parts of the State. There were a few cold nights and frosty mornings the last week, which checked growth to some extent. Range grass was much better than usual and stock of all kinds did well. Alfalfa, grain, and early garden truck made good progress. Irrigation water was plentiful in all districts.—*J. H. Smith.*

New England.—Excepting May, 1889, with a mean temperature of 59.2°, the month was the warmest of its name in the history of the New England Climate and Crop service. The weather was generally favorable to farm operations and to crops, and especially to grass and winter grain. Fruit trees and berries bloomed very full, fruit was setting well and promised good crops. The season at the close of the month was near the average.—*J. W. Smith.*

New Jersey.—The weather was generally favorable for truck farming, except in the extreme southern portion where a scarcity of rainfall retarded growth and the setting out of sweet potatoes and other truck plants. Corn was all planted; much replanting was necessary, owing to failure of seed to germinate. Orchard fruit trees, except peaches, had a fairly good set of fruit. A very large acreage of late round potatoes were planted.—*Edward W. McGann.*

New Mexico.—Drought at beginning of the month partially relieved by showers in second decade, heaviest in northeastern counties; about one-half of the Territory benefited, southwestern districts remained dry and windy. Fair flow for irrigation in upper Rio Grande, Gila, and lower Pecos, but generally water very scarce and farm work at standstill; ranges dormant; stock losses great from lack of food and water; increase of lambs small. Light yields of fruits indicated, owing to frosts and drought.—*Charles E. Linney.*

New York.—First half of month dry and favorable for work, latter half too wet. Farm operations very backward; planting corn and potatoes not finished. Wheat and rye poor; pastures and meadows excellent; small acreage of tobacco; hops doing well; considerable progress made in sowing sugar beets; apples and berries promising; peaches will be extremely light; pears damaged by severe winter; grapes generally promising, but some poor setting reported; fruit damaged by hail on the 25th and 26th.—*R. G. Allen.*

North Carolina.—May was too cool for rapid germination or growth of crops, and showers, though frequent, were light, and the soil dried out rapidly, so that drought prevailed in several central counties. The latter part of the month was warmer and all crops started into rapid growth. Cotton and corn were nearly all planted and fairly good stands secured. Much tobacco was transplanted. Truck crops and gardens did well. Peaches promised a fairly good yield.—*C. F. von Herrmann.*

North Dakota.—The weather was generally quite favorable for farm work. Seeding was frequently interrupted by rain and frosts during the fore part of the month, but the latter part was generally warm and pleasant, and the close found wheat seeding practically finished, while seeding of oats, rye, flax, and barley was well advanced in all sections. Corn planting was in progress in most sections at the end of the month, and grass was abundant and growing rapidly.—*B. H. Bronson.*

Ohio.—The temperature was slightly below normal for the entire State; the highest occurred on the 25th, the lowest on the 11th and 16th. Precipitation was slightly above normal for the State, except a slight deficiency in the middle section. A trace of snow fell on the 15th. Frost on the 16th damaged berries, tender fruits, and garden truck. Much wheat was plowed up, but that remaining improved. Corn planting was slow. Potatoes promising. Tobacco plants plentiful. Oats did well.—*J. Warren Smith.*

Oklahoma and Indian Territories.—May was marked by almost daily precipitation, at times heavy and torrential in character. Wheat and oats were greatly benefited by rains. Cotton and corn were planted by the close of the month, and up to good stand. Kafir and broom corn, millet, castor beans, milo maize, and sweet potatoes were planted, and coming up to good stands. Irish potatoes were being gathered with good yields. Fruit did fairly well. Hail caused some damage to crops.—*C. M. Strong.*

Oregon.—Month deficient in precipitation, but timely showers were well distributed. Nights too cool for rapid growth. Several frosts with but little damage. Fall wheat thrifty and heading well. Early spring grains doing well; late crops made slow growth. Alfalfa harvest begun with satisfactory yields. Pastures excellent. Cattle in fine condition. Lambing season finished with but small loss. Wool clip average. Hops very promising. Fruit prospects good, except Italian prunes, which were lightest in years.—*Edward A. Beals.*

Pennsylvania.—Nearly seasonable weather conditions prevailed during May, but the cold, saturated soil caused much of the early seeded corn to rot before germinating, and much replanting was necessary. Grain that survived the winter made fair progress. At the close of the month oats and grass were well advanced. Tobacco and garden truck were backward, but thrifty. With the exception of peaches, most fruits bloomed profusely.—*T. F. Townsend.*

Porto Rico.—Rainfall generally light until the last week, when heavy showers occurred. The land became hard and dry in places, delaying planting of cane and small crops. Sugar making was finished at some haciendas early in the month, and by the close most of the cane had been ground; the yield was generally good. Young canes were in excellent condition. Many plots of corn, beans, and other crops were planted, and corn and beans were harvested. Early planted cotton did well. The outlook for the next coffee crop did not improve. Mangoes and pineapples were marketed. Stock continued in good condition.—*E. C. Thompson.*

South Carolina.—The nights were unusually cool, which retarded germination and growth of vegetation during the first twenty days. Drought prevailed generally, but was partially relieved by copious showers on the last three days. The weather was favorable for cultivation of field crops, and for finishing planting operations. Oat harvest was begun about the 15th. Corn and cotton remained small, and stands were not satisfactory, owing principally to the dry weather, which also reduced the yields of truck along the coast.—*J. W. Bauer.*

South Dakota.—Conditions were generally favorable for field work and for the germination and growth of spring wheat, oats, barley, spelt, and spring rye, seeding of which was practically completed by the 20th. Corn planting was nearly completed, but poor seed necessitated some replanting, and cool, damp soil retarded germination and growth. Potato planting and the sowing of flax and millet progressed favorably. Grass was backward, but by the 20th afforded good pasturage.—*S. W. Glenn.*

Tennessee.—Favorable conditions until the 14th were followed by a week of dry, cool weather, with light frosts, which injured young crops, especially cotton. The last week was warmer, with fine rains on the 29th and 30th. At the close of the month cotton was small and making slow progress; corn, potatoes, gardens, spring oats, and meadows were doing fairly well; tobacco setting was in progress; wheat was heading well; fruit prospects were fairly good.—*H. C. Bate.*

Texas.—The precipitation conditions of the month were generally favorable. The first and second decades were too cool for rapid growth, but favorable temperature conditions prevailed during the last decade. Cotton planting was completed in the eastern half of the State during the

SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS, MAY, 1904.

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes. Station.	Highest.	Date.	Station.	Lowest.	Date.	Section average.	Departure from the normal.	Greatest monthly. Station.	Amount.	Least monthly. Station.	Amount.
Alabama	69.6	— 1.8	Dothan	99	28	Oneonto	37	15	2.98	—0.56	Camp Hill	5.50	Ozark	0.66
Arizona	70.0	— 0.2	{Fort Grant / Aztec	107 / 107	14 / 26	Flagstaff	20	2	0.50	+0.33	Parker	2.00	7 stations	0.00
Arkansas	67.1	— 2.3	Lonoke	98	23	Dodd City	31	12	3.39	—1.34	Eureka Springs	6.08	Winchester	1.39
California	64.9	+ 2.4	Indio	113	8	Bodie	15	1	0.22	—0.89	Crescent City	1.96	54 stations	0.00
Colorado	51.6	— 1.6	Delta	97	19	Clear View	6	3	2.75	—0.87	Alford	8.18	Conejos	0.00
Florida	74.9	— 2.7	{Lake City / Tarpon Springs	100 / 100	27 / 30	Marianna / Molino	44	11 / 11	2.51	—1.01	Key West	13.01	Lake City	0.30
Georgia	70.2	— 1.2	Blakeley, Fitzgerald	102	28	Clayton	38	1	2.23	—0.85	Clayton	4.44	Fitzgerald	0.64
Idaho	53.5	.....	Garnett, Payette	90	21	Paris	12	8	0.70	.....	Forney	1.75	Blackfoot	T.
Illinois	62.2	— 0.9	Peoria	93	21	Lanark	27	15	3.43	—0.64	Olney	6.56	Chicago	1.54
Indiana	62.0	— 0.5	Rome	95	25	5 stations	29	16	3.35	—0.63	Farmersburg	5.87	Paoli	1.41
Iowa	59.6	— 0.8	Ridgeway	93	22	Charles City	27	15	3.78	—0.35	Onawa	8.15	Clearlake	1.50
Kansas	62.4	— 2.5	{Englewood / Achilles, Norton / Garden City, Viroqua	94 / 94 / 94	23 / 24 / 31	Hanover	21	14	5.81	+1.86	Olathe	11.71	Wallace	1.28
Kentucky	65.0	— 0.9	Shelby City	98	25	{Eubank / Williamsburg / Liberty Hill	33 / 33 / 43	15 / 15 / 15	3.05	—0.65	Shelby City	6.24	Paducah	1.21
Louisiana	72.0	— 1.9	Reserve	97	28	{Plain Dealing / Mansfield / Robelin	43 / 43 / 43	15 / 15 / 1	3.20	+0.02	Ruston	6.55	Houma	1.01
Maryland and Delaware	64.2	+ 1.2	Boettcherville, Md	102	25	Oakland, Md	26	12	2.54	—1.41	Clear Spring	4.23	Millsboro, Del	1.33
Michigan	55.0	+ 0.8	5 stations	90	25	Mancelona	12	11	3.87	+0.10	Petosky	11.09	South Haven	1.05
Minnesota	55.4	— 0.6	Milan, Montevideo	90	22	Pokegama Falls	19	15	2.43	—0.75	Saint Charles	5.44	Leech Lake Dam	0.76
Mississippi	70.1	— 2.3	Okolona	101	23	4 stations	40	14, 16	2.80	—0.50	Leakesville	5.59	Pontotoc	0.42
Missouri	63.1	— 1.9	Jackson	95	24	Trouton	32	15	5.03	+0.22	Kansas City	10.70	Doniphan	1.45
Montana	51.6	— 1.0	Lodgegrass	95	28	{Wolsey / St. Peters	18 / 18	8 / 25	1.44	—0.76	Red Lodge	4.29	Chester	0.16
Nebraska	59.2	— 0.6	Bartley	100	24	Agate	21	9	3.68	+0.02	Blair	7.87	Central City	1.24
Nevada	54.0	+ 1.2	Martins Ranch	98	23	Eureka	10	23	0.85	—0.16	Wood	3.02	3 stations	0.00
New England*	58.7	+ 3.4	{Nashua, N. H / Westboro, Mass	91 / 91	26 / 26	Fort Fairfield, Me	20	1	3.53	—0.27	Thomaston, Me	7.00	Norfolk, Mass	1.80
New Jersey	62.8	+ 2.4	Indian Mills	97	25	Charlottsburg	31	3	2.60	—1.65	Asbury Park	6.69	Atlantic City	1.01
New Mexico	61.2	+ 0.1	{Alamogordo / Carlsbad	99 / 99	29 / 7	Winsors	17	9	0.73	—0.39	Eagle Rock Ranch	2.70	Deming	0.00
New York	59.2	+ 3.2	Rome	95	25	Perry City	22	11	3.28	+0.07	Adams Center	6.83	Richmondville	1.10
North Carolina	66.3	— 0.8	{Henrietta, Moncure / Monroe	95 / 95	24 / 24	Linville	28	16	3.43	—0.70	Jefferson	10.05	Currituck	0.94
North Dakota	54.2	+ 0.8	Wishek	93	4	Larimore	20	14	1.76	—0.57	Walhalla	3.42	Medora	0.11
Ohio	60.7	— 0.5	{Hanging Rock / Waverly	95 / 95	25 / 25	Hedges / New Bremen	27 / 27	16 / 16	3.79	+0.16	Garrettsville	7.62	New Bremen	1.55
Oklahoma and Indian Territories	67.4	— 1.6	Eldorado, Okla	100	30	Taloga, Okla	36	14	4.94	+0.23	Okmulgee, Ind T	10.66	Kenton, Okla	0.99
Oregon	56.0	+ 0.8	Riverside	98	21	Pine, Riverside	22	5	0.91	—1.47	McKenzie Bridge	2.64	Beulah	0.00
Pennsylvania	61.6	+ 2.3	{Johnstown / Lock Haven / Mauch Chunk	94 / 94 / 94	25 / 25 / 25	Smethport	21	12	3.78	—0.52	Warren	7.50	Gettysburg	2.07
Porto Rico	76.4	.....	Manati	97	23	Carozal	51	11	4.77	.....	Les Marias	15.71	Barros	1.04
South Carolina	70.6	— 1.4	Gaffney	99	24	Liberty	38	17	2.04	—1.34	Walhalla	4.67	Sumter	0.23
South Dakota	57.5	0.0	Elkpoint	92	22	Ramsey	22	14	2.46	—0.23	Fort Meade	4.52	Hotch City	0.41
Tennessee	65.8	— 1.3	Hohenwald	97	25	{Hohenwald / Rugby	30 / 30	15, 16 / 15	3.81	+0.11	Grace	6.90	Rogersville	2.13
Texas	72.5	— 1.4	Cotulla	103	31	Tulia	37	9	4.56	+1.26	Austin	11.37	El Paso	0.06
Utah	56.2	— 0.8	Rockville	100	17	Emery	15	1	1.71	+0.75	Tooele	3.84	Terrace	0.07
Virginia	64.0	— 0.8	{Columbia / Woodstock	95 / 95	28 / 24	Bigstone Gap	30	17	3.10	—1.03	Hot Springs	5.80	Petersburg	1.24
Washington	54.4	— 0.8	Kennewick	94	21	Waterville	22	11	0.76	—1.53	Clearwater	4.43	2 stations	0.00
West Virginia	61.8	— 0.2	Ryan	98	25	Powellton	25	16	3.55	—1.06	Leonard	5.80	Creston	1.54
Wisconsin	56.0	— 0.4	{Koepenick / Prairie du Chien	90 / 90	3 / 22	Spooner	22	15	4.73	+0.17	Antigo	8.60	Ashland	1.09
Wyoming	48.6	— 1.2	Embar	91	24	Grand Canyon (Yellowstone Park)	9	8	2.55	+1.35	Cheyenne	6.66	Basin	0.58

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

early part of the month and progressed rapidly in the western half after the rains of the first week; good stands were generally secured; growth was very slow during the first and second decades on account of the cool weather. In the southern portion early planted cotton was putting on squares the latter half of the month. Boll weevils increased rapidly in the southwestern and central portions the last two weeks, but the cotton crop was not sufficiently matured for them to cause damage. Conditions were very favorable for corn. At the close of month it was in tassel in the middle and northern portions and in roasting ears in the southern portion. Rice and sugar cane did well. Fall wheat and oats were being harvested the latter part of the month.—*L. H. Murdoch.*

Utah.—First decade was cold and rainy, stopping practically all work and growth, but warm, clear weather followed and all vegetation made excellent showing. Frost in scattered localities did slight damage. Gardens were yielding well. Beets were thrifty and thinning was progressing. Fruit was well advanced and cherries were ripening in the southern counties. The range was holding out well and stock was in good condition. Sheep shearing was completed and the wool clip was generally good. Irrigation water was plentiful.—*R. J. Hyatt.*

Virginia.—The weather during the first and second decades of May was rather too cool for good crop growth, but during the last decade the conditions of temperature and moisture were seasonable and vegetation advanced rapidly. Winter wheat and spring oats improved materially. Very little tobacco was transplanted. Corn, though small, passed through the month satisfactorily, and at its close was vigorous and growing well. Truck crops were freely marketed. The prospect for fruit, except apples, was poor.—*Edward A. Evans.*

Washington.—Although the month was exceptionally dry the crops did not suffer, because the soil was already well saturated. During the month vegetation recovered, in a great measure, from its backward state. Winter wheat made fine progress and was headed out at the end of the month. Spring wheat, barley, and oats grew slowly and needed rain and

warmer weather. Spring wheat seeding and potato planting were finished by the 15th.—*G. N. Salisbury.*

West Virginia.—The weather during the greater part of May was very favorable for crop growth and farm work. Plowing and planting progressed rapidly and were about completed. Oats, meadows, and pastures grew rapidly and were looking well. Wheat and rye improved greatly, but the prospect was for light yields. Potatoes made good growth, and stock was in fine condition. The prospect for apples, peaches, pears, and cherries was less encouraging, as there was considerable dropping.—*E. C. Vose.*

Wisconsin.—The progress of crops for the month, as a whole, was generally satisfactory. Winter wheat and rye and spring grains, although retarded by the cold, wet weather during the early part of the month, made substantial and healthy growth. Corn planting was delayed by the wet weather, and there was much complaint of poor germination. Meadows and pastures made satisfactory growth. Strawberries and cranberries were very promising; apples good; blackberries and raspberries promised light crops.—*W. M. Wilson.*

Wyoming.—The unusually heavy precipitation was extremely favorable for the ranges, and at the close of the month they were in excellent condition. The cool, wet weather delayed seeding somewhat and prevented rapid growth of gardens, grain, and alfalfa. Stock made good gains, but some lambs and calves were lost during the storms. Streams were high and prospects excellent for a good supply of water for irrigation.—*W. S. Palmer.*

SPECIAL ARTICLES.

STUDIES ON THE CIRCULATION OF THE ATMOSPHERES OF THE SUN AND OF THE EARTH.

VI.—THE CIRCULATION IN CYCLONES AND ANTICYCLONES, WITH PRECEPTS FOR FORECASTING BY AUXILIARY CHARTS ON THE 3500-FOOT AND THE 10,000-FOOT PLANES.

By Prof. FRANK H. BIGELOW.

In my paper on "The mechanism of countercurrents of different temperatures in cyclones and anticyclones," MONTHLY WEATHER REVIEW, February, 1903, some account was given of the construction of the auxiliary charts of barometric pressures for the United States on the 3500-foot and the 10,000-foot planes, to correspond with the daily weather map on the sea-level plane. These new charts have been prepared daily since December 1, 1902, and they have been carefully studied from that time with two purposes in view, the results of the examination being briefly stated in this paper, while the more detailed explanation will appear in Volume II of the Annual Report of the Chief of the Weather Bureau for 1903–4. The first purpose concerns the information they have given as to the actual circulation in the strata above the surface, and its relation to several theories which have been advanced to account for these local circulations, and the second has regard to the derivation of precepts useful in forecasting the weather. It is quite impossible, I presume, to convey to one who has not had an opportunity to see these upper-level charts any adequate impression of their significance to modern meteorology, or of the transformations which take place in the structure of the three systems of isobars, as a cyclone passes over the United States. They must be taken together for the best results, and the study of their *mutual* configurations and variations affords us an insight into the true cause of storm formation, which is decisive as to their nature, and is of especial interest to the intelligent forecaster.

THE STRUCTURE OF THE ISOBARS AT DIFFERENT LEVELS.

In the MONTHLY WEATHER REVIEW for January and February, 1903, several examples were given of the configuration of the isobars in cyclones on the three reference planes, and also of their resolution into two components, namely, the normal isobars of the month and the abnormal or disturbance isobars, which, when added to the normal isobars, produce the observed isobars of the date. The normal monthly isobars were taken from the Barometry Report, 1900–1901, and the separation of the two systems was made by means of a graphical construction. Our purpose was to separate the strictly local disturbance circulation from the general circulation, so far as the isobars are concerned, and to compare this component of the pressure with the wind vectors which had been derived from the cloud observations of 1896–97, a summary of which was given in the MONTHLY WEATHER REVIEW for March, 1902. To illustrate this process, Charts XII and XIII for February 3, 1903, are introduced.

Chart XII, fig. 63, gives the sea-level isobars as on the weather map for February 3, 1903; fig. 64 gives in black the isobars of the same date on the 3500-foot plane, and in red those on the 10,000-foot plane. The components are given on Chart XIII, where the black lines on fig. 65 give the normal system for February on the 3500-foot plane undisturbed by cyclonic action, and the red lines the abnormal system, which, when added to the normal, produces the black lines of fig. 64. The black lines in fig. 66 give the normal and the red lines the abnormal system on the 10,000-foot plane. Since the disturbance on the sea-level plane is not much affected by the normal system, the resolution into components is omitted. It follows that we shall properly compare together fig. 63 and the abnormal systems, or red lines, on figs. 65 and 66 when discussing the theory of cyclonic gyrations. In the course of the year numerous modifications of the fundamental type occur, but in all cases it is not difficult to detect what this modification is and to be certain that we are dealing with one simple, natural structure to which every theory must conform to become acceptable.

In order that we may concentrate attention more closely upon the primary structure, which suffers numerous modifications in the local circulation, an example is given on Chart XIV of a typical system of the normal and of the abnormal isobars, such as occur in a well developed cyclone for the month of February, upon which to base certain conclusions that are in fact sustained by the entire series, without any sort of contradictory or conflicting evidence. Chart XIV, figs. 67, 68, and 69 give the normal, and figs. 70, 71, and 72 the abnormal isobars on these planes.

The discussion can not be considered complete without joining with the isobars the corresponding systems of isotherms at all three levels, but in the present stage of our study it is not possible to do this with accuracy in the higher levels. The temperature conditions in the upper strata can not be reached by direct computation, as has been done with the isobars, until a very much more extended series of actual measurements than we now possess has been made by means of balloon and kite ascensions, such as are proposed at the Mount Weather Observatory. On this account the resolution of the isotherms into their normal and abnormal exponents is now limited to the sea-level plane, or rather, to the surface of the United States. An example is taken from the map of February 27, 1903, which is reproduced on Chart XV, figs. 73 and 74, where the isotherms are printed in red. The temperature components are formed by exactly the same method as was employed in resolving the isobars, the normal temperature system being taken from the Barometry Report. Fig. 73 gives the weather map, and fig. 74 the normal and abnormal isotherms.

THE GEOMETRICAL CONSTRUCTION OF HIGH AND LOW PRESSURE AREAS.

From the study of the isobars on the three planes, it is possible to draw several important conclusions which have the value of general principles. It was shown in the MONTHLY WEATHER REVIEW for February, 1903, fig. 25, "The formation of local anticyclones and cyclones in the general circulation about the poles," that the distribution of pressure commonly observed can be approximately reproduced by the superposition of systems of concentric circles, representing positive and negative local additions to the general circles of the hemis-